Calibrating USPSA Major Matches

A Preliminary Proposal for Match-Based Classification

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Abstract

In this article, we present a preliminary proposal for a new method of incorporating match results into the USPSA classification system. By calibrating match results to classification percentages using a linear regression approach, we aim to create a system that would allow shooters' classifications to be based on real match performance, rather than solely on classifier stages. This proposed method addresses several shortcomings of the traditional classification system, including the underutilization of major match results and the vulnerability of standard regression methods to outliers. We demonstrate the potential effectiveness of this approach using the 2024 Carry Optics Nationals, showing a strong correlation between match results and classification. Additionally, we discuss potential challenges and provide initial recommendations for incorporating non-national matches into the classification system. This work represents an early-stage proposal for a more transparent, data-driven approach to classifying shooters, potentially providing a reliable predictor of performance that can evolve with the sport.

1 Introduction

On March 28, 2025, the United States Practical Shooting Association (USPSA) announced an update to its classification system, aimed at enhancing fairness, accuracy, and consistency. These changes took effect on April 4, 2025 [1].

The update includes adjustments to high-hit factors (HHFs) and algorithm refinements, such as the removal of protective flags and an increased score ceiling. These modifications ensure standardized difficulty levels and more accurately reflect a shooter's true performance in a match setting.

Most notably, the updated system was backtested against historical classification data, revealing **a stronger correlation** between classifications and major match performances. This means the new classification system serves as a more reliable predictor of match placements. Conversely, match placements can also be used to predict a shooter's classification, meaning they can be intercalibrated.

In the past, major match results were underutilized due to a poorly designed classification system. Several issues contributed to this:

1. Major match results counted as classifier scores only under strict conditions, such as the requirement that at least three Grandmasters perform at 90% or higher. As a result, the majority of major match performances were excluded from classification consideration, making the system overly reliant on standalone classifier stages, which had their own flaws.

2. Discrepancies between classification percentages and actual match performance were widespread. On average, shooters performed approximately 9% below their classification percentages at major matches.

3. The system mixed two fundamentally different metrics: match percentages (which represent a shooter's fraction of total match points) and classification scores (which measure performance relative to an arbitrary high-hit factor). This mismatch further muddied the classification process.

For these reasons, major match results, despite being the most accurate representation of a shooter's performance, were not effectively used in the classification system. **These issues underscored the need for reform**.

While match percentages and classification scores are fundamentally different and should not be directly mixed, the updated classification system is designed to enforce a strong linear correlation between them. This opens the possibility of calibrating match scores to their equivalent classification scores for classification purposes. To address this opportunity, we are exploring the establishment of such a calibration through a **linear regression model**.

With this proposed approach, match percentages could potentially be reliably used for classification purposes, allowing for a more performance-driven system. Moreover, **the strict criteria** currently required for a major match to qualify as a classifier, such as the presence of multiple high-performing Grandmasters, could be **significantly relaxed**. This preliminary proposal, which we present here for community feedback and further development, could pave the way for match-based classification to become more common and more representative of a shooter's true ability.

2 Methodology

The following methodology describes our proposed approach to match calibration. In order for this method to work, the match results must exceed certain correlation with the classification percentage. Suppose we obtain a match result consisting of a set of match percentages $y \in \{y_1, y_2, y_3, \dots\}$, these shooters have classification percentages $x \in \{x_1, x_2, x_3, \dots\}$, that are obtained from the updated classification system.

2.1 Correlation

The correlation between these two sets of data is then defined as

$$\mathrm{C_{xy}} = \frac{\mathbb{E}\left[(x - \bar{x})(y - \bar{y})\right]}{\sigma(x - \bar{x})\sigma(y - \bar{y})} \,, \tag{1}$$

where $\mathbb{E}(\cdot)$ denotes the expected value, $\sigma(\cdot)$ denotes the standard deviation, and $\bar{x}$ and $\bar{y}$ denote the mean values of the match percentages and the classification percentages, respectively.

2.2 Linear regression

If the correlation between match percentages and classification percentages were a perfect 100%, then match percentages could be expressed as a linear function of classification percentages, i.e.,

$$y = mx + c \,, \tag{2}$$

where m and c are constants.

In reality, the correlation between match percentage and classification percentage is not perfect, and each individual data point (x, y) may suggest a slightly different relationship. As a result, the values of m and c will vary across the dataset.

To find the best-fitting linear relationship that represents the overall trend, we seek a pair of constants m and c that minimizes the discrepancy between the predicted and actual match percentages. This procedure is known as *linear regression*.

A common approach to performing linear regression is the least squares method. This method minimizes the mean squared error (MSE), defined as

$$\mathrm{MSE} = \frac{1}{n}\sum_{i=1}^{n}\left[y_i - (mx_i + c)\right]^2 \,, \tag{3}$$

by finding the values of m and c that best fit the data.

This optimization ensures that the overall difference between the observed match percentages y_i and the predicted values $mx_i + c$, based on classification percentages x_i, is as small as possible on average.

In major matches, we often observe systematic outliers, shooters with high classification percentages who perform poorly in actual competition. These deviations can arise from various factors, such as equipment malfunctions, DNFs (Did Not Finish), or cases of over-classification.

The mean squared error metric used in the least squares method is particularly sensitive to such outliers. Since MSE penalizes larger errors quadratically, even a small number of extreme cases can disproportionately influence the regression results. As a consequence, the estimated calibration factors m and c may be significantly skewed, reducing the overall accuracy of the model.

To address the sensitivity of the least squares method to outliers, we propose using the mean absolute error (MAE) as the regression metric. Unlike MSE, MAE is more robust against outliers, as it penalizes deviations linearly rather than quadratically. The MAE is defined as

$$\text{MAE} = \frac{1}{n} \sum_{i=1}^{n} |y_i - (mx_i + c)| \ . \tag{4}$$

In this work, we employ the Nelder-Mead numerical optimization algorithm to minimize the MAE. This is the same method previously used in the high hit factor determination algorithm.

2.3 Calibration

Once the calibration factors m and c are obtained, the match is considered calibrated, enabling a meaningful conversion between match percentages and classification scores.

The match bump brackets, the thresholds used to determine classifications based on match performance, can now be computed as:

$$\text{Match bump brackets (GM, M, A, B, C)} = m \times (95, 85, 75, 60, 40) + c \ . \tag{5}$$

Likewise, an individual match percentage can be converted to an equivalent classification percentage using the inverse transformation:

$$\text{Equivalent classification percentage} = \frac{\text{Match percentage} - c}{m} \ . \tag{6}$$

3 Results

To demonstrate this method, we apply it to calculate the match bump brackets for the 2024 Carry Optics Nationals. In this analysis, each shooter's classification percentage is determined using the updated classification algorithm [1], based solely on classification scores prior to the match.

3.1 2024 Carry Optics Nationals

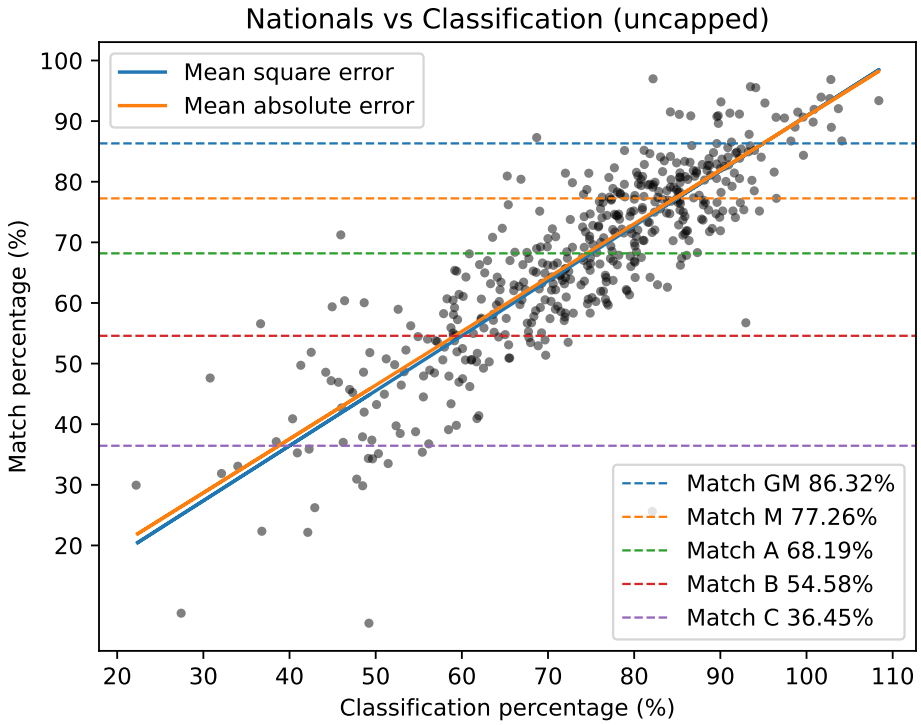

Figure 1: 2024 Carry Optics Nationals performance vs Classification

Fig. 1 plots match percentages against classification. Each dark circle represents an individual shooter, and 458 total shooters are included in this analysis.

As shown in Figure 1, the match results from Nationals exhibit a **strong positive correlation** with classification percentages, that is, shooters with higher classifications generally perform better in the match. The calculated correlation coefficient between match percentages and classification percentages is **85.7%**.

This high degree of correlation justifies establishing a quantitative relationship between match results and classification scores in this case. The calibration factors m and c are shown in Table 1.

	m	c
MSE	0.9069	0.1699
MAE	0.8873	2.065

Table 1: Calibration factors

The best-fit lines obtained using the mean squared error and mean absolute error methods are shown in the figure as blue and yellow lines, respectively. As illustrated, both regression lines capture the overall trend between match percentages and classification percentages reasonably well, providing effective models for the match-to-classification relationship.

The match bump brackets derived from both methods are presented in Table 2. As shown, the results from the two methods are nearly identical in this case.

	GM	M	A	B	C
MSE	86.3%	77.3%	68.2%	54.6%	36.4%
MAE	86.4%	77.5%	68.6%	55.3%	37.6%

Table 2: Match bump brackets

3.2 Effect of outliers

To examine the effect of outliers, we introduced 6 additional outliers into the dataset, each representing underperforming shooters.

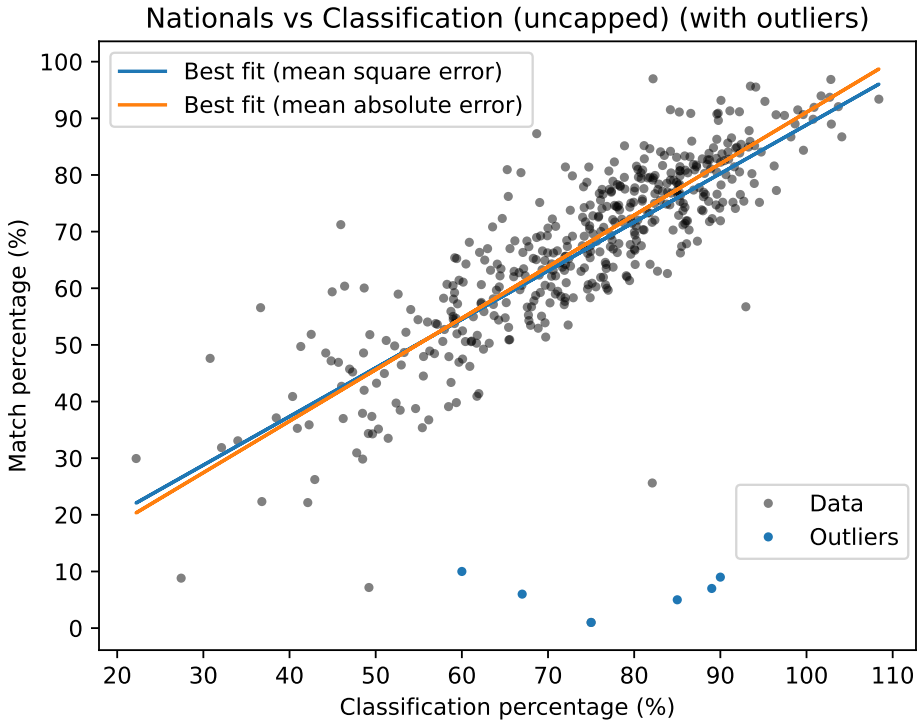

Figure 2: 2024 Carry Optics Nationals performance vs Classification, with outliers added

The 6 outliers are shown as blue circles in Figure 2. As observed, these outliers significantly skew the best-fit line obtained using the mean squared error method, pulling it towards the outliers and deviating from the main trend.

	GM	M	A	B	C
MSE	84.5%	76.0%	67.4%	54.5%	37.4 %
MAE	86.5%	77.4%	68.3%	54.7%	36.5%

Table 3: Match bump brackets (with outliers)

As shown in Table 3, the MSE method results in GM and M brackets that are significantly lower than those in Table 2. In contrast, the MAE method produces brackets that are much closer to the original values, highlighting the robustness of the mean absolute error method in handling outliers. For this reason, the MAE method appears to be the preferred approach moving forward.

4 Discussions

4.1 How calibrated matches might be used

Under this proposed system, calibrated match results could potentially be used to determine a shooter's classification from virtually any match, provided the match meets certain eligibility criteria. For national championships, we suggest these eligibility requirements should be waived, as they represent the most legitimate competitions and should be used to determine a shooter's classification.

We are still in the process of determining how to incorporate other matches into the classification system. The following discussion, however, applies exclusively to national matches.

There are several ways to incorporate match results into a shooter's classification, all based on the equivalent classification percentages calibrated from match results. Ideally, we want to integrate match results into classification in a way that allows shooters to build upon them, rather than relying on traditional match bumps. Matches should also have a more significant role in determining classification, compared to a single classifier stage.

Here are a few potential approaches to achieve this:

1. Equivalent classification percentages from national matches could count as multiple entries (e.g., 8 entries) toward a shooter's classification score.
2. Shooters could have separate match-based classification and classifier-based classification, with the higher of the two determining the shooter's classification.

At this stage, we don't have a clear implementation plan for this system, and we welcome any feedback or suggestions.

4.2 Post-match analysis

One downside of this approach is that the match bump criteria can become convoluted and difficult to understand. This is because there is no clear indication of the performance required to achieve a match bump prior to the match. The calibration only occurs after the match, making it challenging for shooters to know in advance what level of performance is needed.

4.3 Eligibility criteria

Matches, other than nationals, must satisfy eligibility criteria in order to be used for classification purposes. These criteria should align with the assumptions of the calibration approach and not be arbitrarily defined (e.g., requiring a specific number of Grandmasters all shooting 90% or above).

For now, we can identify three criteria that should be met:

1. The **correlation** between match results and classification must be equal to or higher than that of past nationals.
2. The **mean absolute error** between match results and classification must be equal to or lower than that of past nationals.
3. The **number of shooters** in a division must exceed a certain threshold. Further study is required to determine the exact number.

5 Conclusions

The calibration method proposed in this preview represents a potential significant improvement in the USPSA classification system by utilizing real match performance to determine classifications. By addressing the issues with traditional classifier-based systems, this approach could provide a more robust and transparent method that better reflects the true abilities of shooters. Through the use of linear regression and the mean absolute error method, we aim to ensure that outliers would have minimal impact, enhancing the system's reliability. Our preliminary analysis of the 2024 Carry Optics Nationals demonstrates the potential effectiveness of this method, showing a strong correlation between match performance and classification. However, significant challenges remain in incorporating non-national matches into the system, and further study is required to establish eligibility criteria. We present this approach as a starting point for discussion, with the hope that a refined version could eventually make match-based classifications a more integral part of the USPSA classification process, offering shooters a more accurate and actionable reflection of their performance.

References

[1] USPSA Classification Committee. Enhancing fairness, accuracy, and consistency in classification. https://uspsa.org/announcement/967.